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Practitioner's Docket No. AP9265

CHAPTER II

TRANSMITTAL LETTER
TO THE UNITED STATES ELECTED OFFICE (EO/US)

(ENTRY INTO U.S. NATIONAL PHASE UNDER CHAPTER II)

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP99/03761	31/May/1999	5/June/1998

Device and Method for Actuating a Brake System for Automotive Vehicles
TITLE OF INVENTION

Alfred Eckert
APPLICANT(S)

Box PCT
Assistant Commissioner for Patents
Washington D.C. 20231
ATTENTION: EO/US

NOTE: *To avoid abandonment of the application, the applicant shall furnish to the USPTO, not later than 20 months from the priority date: (1) a copy of the international application, unless it has been previously communicated by the International Bureau or unless it was originally filed in the USPTO; and (2) the basic national fee (see 37 C.F.R. § 1.492(a)). The 30-month time limit may not be extended. 37 C.F.R. § 1.495.*

WARNING: *Where the items are those which can be submitted to complete the entry of the international application into the*

CERTIFICATION UNDER 37 C.F.R. 1.10*
*(Express Mail label number is **mandatory**.)*
(Express Mail certification is optional.)

I hereby certify that this correspondence and the documents referred to as attached therein are being deposited with the United States Postal Service on this date 12-5-00, in an envelope as "Express Mail Post Office to Addressee," Mailing Label Number EL686849610US, addressed to the: Assistant Commissioner for Patents, Washington, D.C. 20231.

Joyce Krumpe
(type or print name of person mailing paper)

Joyce Krumpe
Signature of person mailing paper

WARNING: *Certificate of mailing (first class) or facsimile transmission procedures of 37 C.F.R. 1.8 cannot be used to obtain a date of mailing or transmission for this correspondence.*

***WARNING:** *Each paper or fee filed by "Express Mail" **must** have the number of the "Express Mail" mailing label placed thereon prior to mailing. 37 C.F.R. 1 10(b).*
*"Since the filing of correspondence under § 1.10 without the Express Mail mailing label thereon is an oversight that can be avoided by the exercise of reasonable care, requests for waiver of this requirement will **not** be granted on petition." Notice of Oct. 24, 1996, 60 Fed. Reg 56,439, at 56,442.*

national phase are subsequent to 30 months from the priority date the application is still considered to be in the international state and if mailing procedures are utilized to obtain a date the express mail procedure of 37 C.F.R. §1.10 must be used (since international application papers are not covered by an ordinary certificate of mailing - See 37 C.F.R. §1.8

NOTE: *Documents and fees must be clearly identified as a submission to enter the national state under 35 USC 371 otherwise the submission will be considered as being made under 35 USC 111. 37 C.F.R. § 1.494(f).*

1. Applicant herewith submits to the United States Elected Office (EO/US) the following items under 35 U.S.C. 371:

   a. [X] This express request to immediately begin national examination procedures (35 U.S.C. 371(f)).

   b. [X] The U.S. National Fee (35 U.S.C. 371(c)(1)) and other fees (37 C.F.R. § 1.492) as indicated below:

2.Fees

CLAIMS FEE	(1) FOR	(2) NUMBER FILED	(3) NUMBER EXTRA	(4) RATE	(5) CALCULA-TIONS
[ ]*	TOTAL CLAIMS	11 - 20 =		x $ 18.00 =	$
	INDEPENDENT CLAIMS	6 - 3 =	3	x $ 80.00 =	240.00
	MULTIPLE DEPENDENT CLAIM(S) (if applicable) + $260.00				
BASIC FEE**	[ ] U.S. PTO WAS INTERNATIONAL PRELIMINARY EXAMINATION AUTHORITY Where an International preliminary examination fee as set forth in § 1.482 has been paid on the international application to the U.S. PTO: [ ] and the international preliminary examination report states that the criteria of novelty, inventive step (non-obviousness) and industrial activity, as defined in PCT Article 33(2) to (4) have been satisfied for all the claims presented in the application entering the national stage (37 CFR 1.492(a)(4)) .... $96.00 [ ] and the above requirements are not met (37 CFR 1.492(a)(1)) .... $670.00 [X] U.S. PTO WAS NOT INTERNATIONAL PRELIMINARY EXAMINATION AUTHORITY Where no international preliminary examination fee as set forth in § 1.482 has been paid to the U.S. PTO, and payment of an international search fee as set forth in § 1.445(a)(2) to the U.S. PTO: [ ] has been paid (37 CFR 1.492(a)(2)) .... $760.00 [ ] has not been paid (37 CFR 1.492(a)(3)) .... $970.00 [X] where a search report on the international application has been prepared by the European Patent Office or the Japanese Patent Office (37 CFR 1.492(a)(5)) $860.00				
	Total of above Calculations				= 1100.00
SMALL ENTITY	Reduction by ½ for filing by small entity, if applicable. Affidavit must be filed. (note 37 CFR 1.9, 1.27, 1.28)				-
	Subtotal				1100.00
	Total National Fee				$ 1100.00
	Fee for recording the enclosed assignment document $40.00 (37 CFR 1.21(h)). (See Item 13 below) See attached "ASSIGNMENT COVER SHEET".				
TOTAL	Total Fees enclosed				$ 1100.00

*See attached Preliminary Amendment Reducing the Number of Claims.

i. [ ] A check in the amount of ___________ to cover the above fees is enclosed.

ii. [X] Please charge Account No. 18-0013 in the amount of $ 1020.00 . A duplicate copy of this sheet is enclosed.

***WARNING:* *"To avoid abandonment of the application the applicant shall furnish to the United States Patent and Trademark Office not later than the expiration of 30 months from the priority date: * * * (2) the basic national fee (see § 1.492(a)). The 30-month time limit may not be extended." 37 C F.R. § 1.495(b).*

WARNING: *If the translation of the international application and/or the oath or declaration have not been submitted by the applicant within thirty (30) months from the priority date, such requirements may be met within a time period set by the Office. 37 C.F.R. § 1.495(b)(2). The payment of the surcharge set forth in § 1.492(e) is required as a condition for accepting the oath or declaration later than thirty (30) months after the priority date. The payment of the processing fee set forth in § 1.492(f) is required for acceptance of an English translation later than thirty (30) months after the priority date. Failure to comply with these requirements will result in abandonment of the application. The provisions of § 1.136 apply to the period which is set Notice of Jan. 3, 1993, 1147 O.G. 29 to 40.*

3. [X] A copy of the International application as filed (35 U.S.C. 371(c)(2)):

NOTE: *Section 1 495 (b) was amended to require that the basic national fee and a copy of the international application must be filed with the Office by 30 months from the priority date to avoid abandonment "The International Bureau normally provides the copy of the international application to the Office in accordance with PCT Article 20. At the same time, the International Bureau notifies applicant of the communication to the Office. In accordance with PCT Rule 47.1, that notice shall be accepted by all designated offices as conclusive evidence that the communication has duly taken place. Thus, if the applicant desires to enter the national stage, the applicant normally need only check to be sure the notice from the International Bureau has been received and then pay the basic national fee by 30 months from the priority date." Notice of Jan. 7, 1993, 1147 O.G. 29 to 40, at 35-36. See item 14c below.*

a. [X] is transmitted herewith.

b. [ ] is not required, as the application was filed with the United States Receiving Office.

c. [ ] has been transmitted

i. [ ] by the International Bureau.
Date of mailing of the application (from form PCT/IB/308): __________.

ii. [ ] by applicant on _______.
Date

4. [X] A translation of the International application into the English language (35 U.S.C. 371(c)(2)):

a. [X] is transmitted herewith.

b. [ ] is not required as the application was filed in English.

c. [ ] was previously transmitted by applicant on _________________.
Date

d. [ ] will follow.

5. [ ] Amendments to the claims of the International application under PCT Article 19 (35 U.S.C. 371(c)(3)):

NOTE: The Notice of January 7, 1993 points out that 37 C.F.R § 1.495(a) was amended to clarify the existing and continuing practice that PCT Article 19 amendments must be submitted by 30 months from the priority date and this deadline may not be extended. The Notice further advises that· "The failure to do so will not result in loss of the subject matter of the PCT Article 19 amendments. Applicant may submit that subject matter in a preliminary amendment filed under section 1.121. In many cases, filing an amendment under section 1.121 is preferable since grammatical or idiomatic errors may be corrected." 1147 O.G. 29-40, at 36.

a. [ ] are transmitted herewith.
b. [ ] have been transmitted
i. [ ] by the International Bureau.
Date of mailing of the amendment (from form PCT/IB/308): __________.
ii. [ ] by applicant on _______.
Date
c. [ ] have not been transmitted as
i. [ ] applicant chose not to make amendments under PCT Article 19.
Date of mailing of Search Report (from form PCT/ISA/210): __________.
ii. [ ] the time limit for the submission of amendments has not yet expired. The amendments or a statement that amendments have not been made will be transmitted before the expiration of the time limit under PCT Rule 46.1.

6. [ ] A translation of the amendments to the claims under PCT Article 19 (38 U.S.C. 371(c)(3)):
a. [ ] is transmitted herewith.
b. [ ] is not required as the amendments were made in the English language.
c. [ ] has not been transmitted for reasons indicated at point 5(c) above.

7. [x] A copy of the international examination report (PCT/IPEA/409)
[x] is transmitted herewith.
[ ] is not required as the application was filed with the United States Receiving Office.

8. [ ] Annex(es) to the international preliminary examination report
a. [ ] is/are transmitted herewith.
b. [ ] is/are not required as the application was filed with the United States Receiving Office.

9. [ ] A translation of the annexes to the international preliminary examination report
a. [ ] is transmitted herewith.
b. [ ] is not required as the annexes are in the English language.

10. [X] An oath or declaration of the inventor (35 U.S.C. 371(c)(4)) complying with 35 U.S.C. 115
a. [ ] was previously submitted by applicant on ____________.
Date
b. [ ] is submitted herewith, and such oath or declaration
i. [ ] is attached to the application.
ii. [ ] identifies the application and any amendments under PCT Article 19 that were transmitted as stated in points 3(b) or 3(c) and 5(b); and states that they were reviewed by the inventor as required by 37 C.F.R. 1.70.

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iii. [X] will follow.

Other document(s) or information included:

11. [x] An International Search Report (PCT/ISA/210) or Declaration under PCT Article 17(2)(a):
   a. [x] is transmitted herewith.
   b. [ ] has been transmitted by the International Bureau.
      Date of mailing (from form PCT/IB/308): ________________.
   c. [ ] is not required, as the application was searched by the United States International Searching Authority.
   d. [ ] will be transmitted promptly upon request.
   e. [ ] has been submitted by applicant on ________________.
      Date

12. [X] An Information Disclosure Statement under 37 C.F.R. 1.97 and 1.98:
   a. [X] is transmitted herewith.
      Also transmitted herewith is/are:
      [X] Form PTO-1449 (PTO/SB/08A and 08B).
      [X] Copies of citations listed.
   b. [ ] will be transmitted within THREE MONTHS of the date of submission of requirements under 35 U.S.C. 371(c).
   c. [ ] was previously submitted by applicant on ________________.
      Date

13. [ ] An assignment document is transmitted herewith for recording.

A separate [ ] "COVER SHEET FOR ASSIGNMENT (DOCUMENT) ACCOMPANYING NEW PATENT APPLICATION" or[ ] FORM PTO 1595 is also attached.

____

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____

14. [X] Additional documents:
   a. [ ] Copy of request (PCT/RO/101)
   b. [x] International Publication No. WO99/64281
      i. [ ] Specification, claims and drawing
      ii. [x] Front page only
   c. [X] Preliminary amendment (37 C.F.R. § 1.121)
   d. [ ] Other

____

____

____

15. [X] The above checked items are being transmitted

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a. [X] before 30 months from any claimed priority date.
b. [ ] after 30 months.

16. [ ] Certain requirements under 35 U.S.C. 371 were previously submitted by the applicant on ____________, namely:

____

____

____

AUTHORIZATION TO CHARGE ADDITIONAL FEES

WARNING: *Accurately count claims, especially multiple dependent claims, to avoid unexpected high charges if extra claims are authorized.*

NOTE: *"A written request may be submitted in an application that is an authorization to treat any concurrent or future reply, requiring a petition for an extension of time under this paragraph for its timely submission, as incorporating a petition for extension of time for the appropriate length of time. An authorization to charge all required fees, fees under § 1.17, or all required extension of time fees will be treated as a constructive petition for an extension of time in any concurrent or future reply requiring a petition for an extension of time under this paragraph for its timely submission. Submission of the fee set forth in § 1.17(a) will also be treated as a constructive petition for an extension of time in any concurrent reply requiring a petition for an extension of time under this paragraph for its timely submission." 37 C.F.R. § 1.136(a)(3).*

NOTE: *"Amounts of twenty-five dollars or less will not be returned unless specifically requested within a reasonable time, nor will the payer be notified of such amounts; amounts over twenty-five dollars may be returned by check or, if requested, by credit to a deposit account." 37 C.F.R § 1.26(a).*

[X] The Commissioner is hereby authorized to charge the following additional fees that may be required by this paper and during the entire pendency of this application to Account No. 18-0013.

[X] 37 C.F.R. 1.492(a)(1), (2), (3), and (4) (filing fees)

WARNING: *Because failure to pay the national fee within 30 months without extension (37 C.F.R. § 1.495(b)(2)) results in abandonment of the application, it would be best to always check the above box.*

[X] 37 C.F.R. 1.492(b), (c) and (d) (presentation of extra claims)

NOTE: *Because additional fees for excess or multiple dependent claims not paid on filing or on later presentation must only be paid or these claims cancelled by amendment prior to the expiration of the time period set for response by the PTO in any notice of fee deficiency (37 C.F.R. § 1.492(d)), it might be best not to authorize the PTO to charge additional claim fees, except possible when dealing with amendments after final action.*

[X] 37 C.F.R. 1.17 (application processing fees)
[X] 37 C.F.R. 1.17(a)(1)-(5)(extension fees pursuant to § 1.136(a).
[ ] 37 C.F.R. 1.18 (issue fee at or before mailing of Notice of Allowance, pursuant to 37 C.F.R. 1.311(b))

NOTE: *Where an authorization to charge the issue fee to a deposit account has been filed before the mailing of a Notice of Allowance, the issue fee will be automatically charged to the deposit account at the time of mailing the notice of*

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allowance. 37 C.F.R. § 1.311(b).

NOTE: 37 C.F.R. 1.28(b) requires "Notification of any change in loss of entitlement to small entity status must be filed in the application . . . prior to paying, or at the time of paying . . . issue fee." From the wording of 37 C.F.R. § 1.28(b): (a) notification of change of status must be made even if the fee is paid as "other than a small entity" and (b) no notification is required if the change is to another small entity.

[X] 37 C.F.R. § 1.492(e) and (f) (surcharge fees for filing the declaration and/or filing an English translation of an International Application later than 30 months after the priority date).

SIGNATURE OF PRACTITIONER

Reg. No.: 33,373

Joseph V. Coppola, Sr.
(type or print name of practitioner)

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10291
PATENT TRADEMARK OFFICE

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AP9265

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Eckert

Int'l Application No.: PCT/EP99/03761

Int'l Filing Date: 31/May/1999

Serial No.: Group Art Unit:

Filed: Herewith Examiner:

For: Device and Method for Actuating a Brake System for Automotive Vehicles

Attorney Docket No.: AP9265 Paper No.

Box PCT
Assistant Commissioner of Patents
Washington, D.C. 20231
Attn: EO/US

PRELIMINARY AMENDMENT

Dear Sir:

Please amend the application as follows prior to examination on the merits.

IN THE CLAIMS

Please cancel claims 1-11 and add the following new claims.

CERTIFICATE OF MAILING/TRANSMISSION (37 CFR 1.8(a))

I hereby certify that this correspondence is, on the date shown below, being:

☑ deposited with the United States Postal Service with sufficient postage as Express Mail, Post Office to Addressee, mailing label no.: EL686849610US, addressed to Box PCT, Assistant Commissioner of Patents, Washington, DC 20231

☐ transmitted by facsimile to the Patent and Trademark Office. to Examiner ____ at ____

Joyce Krumpe
Signature
Joyce Krumpe

Date: 12/5/00

12. (New) Device for actuating a brake system to accomplish a brake assist function, comprising:

a control unit damping effect or the counterforce of a brake pedal when a brake assist function is activated,

a sensor for sensing brake pedal travel,

means, coupled to said sensing means, for determining the vehicle deceleration which is to be effected by the brake system.

13. (New) Device as claimed in claim 12, wherein the counterforce is a function of the speed of brake pedal travel or the acceleration of application of the driver's foot for braking and is adjusted to a lower amount when the speed of application or the acceleration of application is high.

14. (New) Device as claimed in claim 12, wherein the counterforce is responsive to pedal travel and rises with an increasing actuating travel.

15. (New) Device as claimed in claim 12, wherein the damping effect depends on the speed of application or the acceleration of application of the driver's foot for braking and is adjusted to a lower amount when the speed of application and/or the acceleration of application is high.

16. (New) Device for actuating a brake system to accomplish a brake assist function, comprising:

a control unit for changing a brake force acting in the system as a function of an actuating travel sensed by a brake pedal sensor, an actuating speed or an acceleration of actuation of a brake pedal when the brake assist function is activated, and wherein the brake force acting in the system corresponds to a ratio between the determined actuating travel and a vehicle deceleration to be effected by the brake system.

17. (New) Device as claimed in claim 16, wherein the brake force acting in the system is augmented with a rising actuating travel, a rising actuating speed, or a rising acceleration of actuation.

18. (New) Device as claimed in claim 16, wherein the brake force acting in the system is reduced continuously to a normal brake force when the actuating travel decreases.

19. (New) Device for actuating a brake system to accomplish a brake assist function, comprising:

a control unit for reducing a damping effect or a counterforce of a brake pedal when the brake assist function is activated,

a sensor for detecting the resulting actuating travel of the brake pedal, wherein the control unit is coupled to the sensor for determining the vehicle deceleration to be effected by the brake system, and wherein the control unit changes a brake force acting in the system depending on the sensed actuating travel, an actuating speed or an acceleration of actuation of the brake pedal when the brake assist function is activated, the said brake force acting in the system corresponding to a ratio between the sensed actuating travel and the deceleration to be effected by the brake system.

20. (New) Method for actuating a brake system to accomplish a brake assist function, wherein a control unit executes the following steps:

reducing a damping effect or a counterforce of a brake pedal when the brake assist function is activated, and

taking into account the resulting actuating travel of the brake pedal which is sensed by way of a sensor of the brake pedal for determining the vehicle deceleration which is to be effected by the brake system.

21. (New) Method for actuating a brake system to accomplish a brake assist function, comprising the steps of:

changing a brake force acting in the system depending on:

i. an actuating travel of a brake pedal sensed by a sensor,

ii. an actuating speed or an acceleration of actuation of a brake pedal when the brake assist function is activated,

wherein the brake force acting in the system corresponds to a ratio between the determined actuating travel and a vehicle deceleration to be effected by the brake system.

22. (New) Method for actuating a brake system to accomplish a brake assist function, wherein a control unit executes the following steps:

reducing a damping effect or a counterforce of a brake pedal when the brake assist function is activated, and

taking into account the resulting actuating travel of the brake pedal which is sensed by way of a sensor of the brake pedal for determining the vehicle deceleration which is to be effected by the brake system, and

changing a brake force acting in the system depending on the actuating travel, the actuating speed or the acceleration of actuation of a brake pedal when the brake assist function is activated, and the brake force acting in the system corresponds to a ratio between the determined actuating travel and a vehicle deceleration to be effected by the brake system.

REMARKS

Prior to a formal examination of the above-identified application, acceptance of the new claims and the enclosed substitute specification (under 37 CFR 1.125) is respectfully requested. It is believed that the substitute specification and new claims will facilitate processing of the application in accordance with M.P.E.P. 608.01(q). The substitute specification and new claims are in compliance with 37 CFR 1.52 (a and b) and, while making no substantive changes, are submitted to conform this case to the formal requirements and long-established formal standards of U.S. Patent Office practice, and to provide improved idiom and better grammatical form.

The enclosed substitute specification is presented herein in both marked-up and clean versions.

STATEMENT

The undersigned, an attorney registered to practice before the office, hereby states that the enclosed substitute specification includes the same changes as are indicated in the mark-up copy of the original specification. The substitute specification contains no new subject matter.

Respectfully submitted,

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Attorney for Applicants

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s/prts

Device and Method for Actuating a Brake System for Automotive Vehicles

The present invention relates to a device and a method for actuating a brake system to accomplish a brake assist function, especially for automotive vehicles.

Active brake force boosters are known in the art which are used to shorten the stopping distance. The brake force booster referred to is actuated independently by a so-called brake assist system. The mode of operation of the brake assist system which improves the braking power of a vehicle when driven by a less experienced driver and, thus, shortens the stopping distance is e.g. as follows. A travel sensor measures the speed of depression of a brake pedal. When the driver hesitates after the spontaneous application of the brake pedal and does not dare to fully depress the pedal until response of the control of an anti-lock system (ABS), the brake assist system will intervene. An electronic control device calculates from the speed by which the braking operation was initiated by the driver whether emergency braking prevails and sends, by way of a magnetic valve, a command to the booster operating in the ON/OFF mode to deliver the full boosting force. The result is that the vehicle is braked in a boosted manner. To prevent the triggered brake assist system from inadvertently decelerating the vehicle until standstill, a release switch is integrated into the booster. The switch will switch off the brake assist system as soon as the driver releases the brake pedal again. The above principle is e.g. described in German patent DE 42 08 496 C1.

However, the above solution suffers from the disadvantage that an inadvertent quick application of the brake pedal may also trigger independent activation of the brake system. Further, it may occur in an unfavorable case that the system is retained in the independently actuated and activated condition when the driver applies a relatively small amount of force to the brake pedal (after the activation by e.g. a quick depression of the brake pedal). This may also lead to an undesirable braking operation. When the brake assist system senses that release of the active booster is desired by the driver, further, a jerk may occur because the brake pressure is reduced suddenly.

An object of the present invention is to provide a device and a method for actuating a brake system to perform a brake assist function,. especially for automotive vehicles, which achieve safe and comfortable shortening of the stopping distance and avoid unintentional activations.

This object is achieved according to the features of the independent patent claims. The dependent patent claims show favorable improvements and embodiments of the present invention.

According to the present invention, a brake pedal can be used which is uncoupled from the brake system inasfar as the quantities, such as the actuating travel of the brake pedal, which are input by the driver into the system and are variable and depend on further inputs, such as the speed of pedal depression, may be converted by a control unit into the vehicle deceleration to be effected by the brake system.

It should be noted in this respect that it is of course possible to use other input variables for converting the driver's input by way of the brake pedal into the desired deceleration. For example, these variables could be the vehicle

speed, vehicle load, a measured yaw torque, the current steering angle, etc.

According to the present invention, for example, damping and/or a counterforce of the brake pedal can be adjusted accordingly by way of a control unit, and the control unit can reduce the damping effect and/or the counterforce of the brake pedal accordingly when the brake assist function is activated, and the resulting actuating travel of the brake pedal which is determined by way of a travel sensor of the brake pedal may then be taken into account for determining the deceleration that is to be effected by the brake system.

According to the present invention, it may thus be ensured in a favorable manner that total control of the brake system by the driver is effected when the brake assist function is activated. This is in contrast to the state of the art described hereinabove because the brake assist system in this prior art actuates the brake system by a corresponding control logic partly independently of the actual position of the brake pedal. This is prevented in the present invention because the deceleration of the brake system is adjusted in dependence on the determined actuating travel (actual position) of the brake pedal. Because the damping effect and/or the counterforce of the brake pedal is reduced, it has to be expected that the driver depresses the brake pedal to a greater extent than in the event when the brake assist function is not activated so that the deceleration effected by the brake system is augmented. The result is a reduced stopping distance.

According to another embodiment, a control unit can change a brake force acting in the system, when the brake assist function is activated, in dependence on an actuating travel determined by the travel sensor, an actuating speed and/or an acceleration of actuation of the brake pedal. The brake force acting in the system can correspond to a ratio of the

determined actuating travel to a deceleration to be effected by the brake system. According to this embodiment, the counterforce and/or damping effect of the brake pedal will not change, instead, the driver's input by way of the brake pedal is boosted to a greater extent so that a shortened stopping distance can also be achieved when the brake assist function is activated.

The above embodiments may of course also be implemented in a combined fashion.

Embodiments of the present invention will be explained in detail in the following by way of schematic drawings. In the drawings,

Figure 1 is a schematic block diagram of the present invention.

Figure 2 is a graph showing the actuating travel of the brake pedal plotted against the actuating force.

Figure 3 is a flow chart for changing the damping effect and/or the counterforce of the brake pedal.

Figure 4 is a graph showing the counterforce (input force) of the brake pedal or the output force of the brake system which is proportional to the deceleration, plotted against time.

Figure 5 is a flow chart relating to an increase of the brake force acting in the system.

A brake pedal 1 with a travel sensor 2 is shown in Figure 1. The travel sensor 2 can sense the actuating angle of the brake pedal 1 or the actuating travel of the brake pedal 1. The travel sensor 2 is connected to a brake system 4 and,

especially, to a control unit 5 by way of a corresponding signal line 3.

In response to the signals of the travel sensor 2 (or the angular sensor), the control unit 5 initially determines whether a brake assist function is required. If this is the case, the control unit 5 will determine, for example, a correspondingly reduced counterforce of the non-illustrated pedal components of the brake pedal 1. These pedal components may include a static portion (spring) and a speed-responsive portion (damping effect). The reduction of the counterforce may be achieved by minimizing damping effect, for example. This may be performed by varying the hydraulic effective cross-section.

The control unit 5 may also leave the damping effect and/or the counterforce of the brake pedal 1 unchanged and increase the brake force acting in the system accordingly when the brake assist function was activated. Of course, influencing the counterforce and/or the damping effect of the brake pedal 1 and of the brake force acting in the system may also be combined.

Depending on the signals sensed by the travel sensor 2 (or angular sensor), a deceleration to be effected by the brake system 4 is now determined by the control unit 5 of the brake system 4. This is done, for example, with the assistance of the determined actuating travel, the determined actuating speed, and/or the determined acceleration of actuation. Of course, other factors may also be taken into account (for example, the vehicle speed, a yaw velocity, a steering angle, etc.).

Depending on the determined deceleration or the determined braking pressure, wheel brakes 6 are now actuated by way of corresponding control lines 7 in order to bring about the desired deceleration (only one wheel brake 6 is shown for the sake of clarity). The control lines 7 may be electric and/or hydraulic control lines to actuate the wheel brakes 6.

The embodiment of Figure 2 shows a graph of the actuating travel plotted against the actuating force (or the input force F_e) of the brake pedal 2. When the brake assist system is not actuated, an actuating travel of the brake pedal 1 of x1 is produced with an actuating force F_{e1}. When the brake assist system is activated, an actuating travel x2 is produced with the same actuating force F_{e1} of the brake pedal 1. By reducing the damping effect and/or the counterforce of the brake pedal, a stronger or deeper depression of the brake pedal 1 by the driver will be achieved, so that the braking distance can be reduced effectively without impairing the entire control of the braking action or braking operation by the driver. The same applies also to the embodiment according to Figures 4 and 5 (as will be explained in the following).

The purpose of the flow chart according to Figure 3 is to represent a possible operating sequence which is executed, for example, by the control unit 5. This sequence is started in step 100, and a poll is made in step 101 whether the brake assist system or the brake assist function is activated. If this is not the case, a line branching back inbetween steps 100 and 101 is made.

As has already been explained hereinabove, activation of the brake assist function may be induced, for example, by the control unit 5 when the speed of depression of the brake pedal 1 is higher than a threshold value (this is, however, meant only as an example for a possible activation input of the brake assist function).

Subsequently, a branch to step 102 is made in which the damping effect and/or the counterforce of the brake pedal 1 is reduced. This may be effected in that hydraulic effective cross-sections of the brake pedal 1 are varied accordingly. Subsequently, the actuating travel x of the brake pedal 1 is sensed in step 103,

and deceleration that corresponds to the actuating travel is determined in step 104. Then, the determined deceleration is output to the brake system in step 105, and the wheel brakes 6 are subsequently actuated so that this deceleration is reached. The above-mentioned operating sequence terminates in step 106.

The static counterforce of the brake pedal 1 (spring and/or damping effect) may thus be limited to a value which corresponds to a thirty percent braking, for example, because the normal range of action of the driver comprises 0 to 30 % deceleration, that means, the driver knows this range of deceleration or the range of the pedal counterforce. This effects an accelerating force surplus of the pedal force on the brake pedal 1, whereby a quicker foot movement and a stronger or deeper depression of the brake pedal 1 takes place. Thus, the pedal travel that results is an indicator of the deceleration to be achieved. The value for the counterforce to be adjusted may e.g. depend on the speed of application of the foot (sensed by the speed of application of the brake pedal 1). Further, a static counterforce (spring effect) which is responsive to the pedal travel can be reduced to a value which e.g. corresponds to a thirty percent braking (lower force-travel characteristic curve). This also effects an accelerating force surplus of the pedal force on the brake pedal 1 and, thus, a quicker foot movement. Still further, the dynamic counterforce (damping effect) can be reduced to a value of the application speed which is possibly responsive to speed, and it should be taken into consideration in the reduction of damping that the tendency of the brake pedal to vibrations (inherent movement of the brake pedal 1) is reliably prevented. In this arrangement, the static pedal characteristic curve would be maintained, and only the motion-hindering damping force would be reduced.

The pedal travel that results is an indicator of the deceleration to be achieved in all solutions mentioned

hereinabove. Of course, all above possibilities can also be combined in any fashion desired.

It should be noted in this respect that the effect of a conventional driver actuation switch can be described by sensing the pedal movement because the pedal is not moved actively.

Figure 4 shows an increase of the brake force acting in the system. The dotted lines show the input force F_e (corresponds to the counterforce) and the output force F_a. The output force F_a is a value which corresponds to the vehicle deceleration. When the brake assist system or the brake assist function is switched on, the brake force acting in the system will be augmented. The uninterrupted solid line shows maximum boosting. After the brake assist system is switched off, the brake force acting in the system will re-approach the normal brake force so that normal brake force will prevail again in the next actuation of the brake system. The approach to the normal brake force takes place continuously or gradually so that the brake force acting in the system is reduced as comfortably as possible.

Of course, any steps desired between the dotted line of F_a and the uninterrupted solid line of F_a are possible. Intermediate values for the brake force acting in the system may be chosen, for example, in dependence on the actuating travel, the actuating speed, and/or the acceleration of actuation of the brake pedal 1 so that the boosted course of the output force F_a is between the solid uninterrupted line and the dotted line. Naturally, the determination of the brake force acting in the system and, thus, also the line representing said may also depend on other factors (for example, the vehicle speed, the vehicle weight, etc.) at a defined time during the activation of the brake assist function and after the activation of the

brake assist function (in the phase of the continuous approach to the normal brake force).

A possibility of an operating sequence which can e.g. be executed in the control unit 5 is shown as an example in Figure 5. After start in step 200 there is a branch to step 201 by polling whether the brake assist function is activated or not. If this is not the case, a branching back inbetween steps 200 and 201 is made. When the brake assist function is activated, the brake force acting in the system is augmented in step 202. Subsequently, the actuating travel of the brake pedal 1 is sensed in step 203. Then a deceleration which corresponds to the sensed actuating travel is determined in step 204, and the brake force acting in the system that is augmented in step 202 is taken into consideration. The deceleration is then output to the brake system 4 in step 205, and the operating sequence terminates in step 206.

When the brake assist function is activated, the mathematical brake force acting in the system (actuating travel or pedal travel in relation to deceleration) is greatly augmented, and the counterforce of the brake pedal 1 is uninfluenced. The resulting brake force acting in the system may depend on the pedal movement (actuating travel, actuating speed and/or acceleration of actuation) and is fixed during the application of the brake (positive pedal speed). During release of the brake, the brake force acting in the system is reduced continuously again until the normal brake force is reached.

The embodiments according to Figures 2 and 3 as well as 4 and 5 may also be combined, of course.

Further, it should be noted that the modules and functions described in the present invention may be realized alone and/or in any combination desired.

Patent Claims:

1. Device for actuating a brake system (4) to accomplish a brake assist function, especially for automotive vehicles, wherein a damping effect and/or a counterforce of a brake pedal (1) can be adjusted by way of a control unit (5), and the control unit (5) reduces the damping effect and/or the counterforce of the brake pedal (1) when the brake assist function is activated, and the resulting actuating travel of the brake pedal (1) which is sensed by way of a sensor (2) of the brake pedal (1) is taken into account for determining the vehicle deceleration which is to be effected by the brake system (4).

2. Device as claimed in claim 1, c h a r a c t e r i z e d in that the counterforce depends on the speed of application and/or the acceleration of application of the driver's foot for braking and is adjusted to a lower amount when the speed of application and/or the acceleration of application is high.

3. Device as claimed in claim 1 or 2, c h a r a c t e r i z e d in that the counterforce is responsive to pedal travel and rises with an increasing actuating travel.

4. Device as claimed in at least one of claims 1 to 3, c h a r a c t e r i z e d in that the damping effect depends on the speed of application and/or the acceleration of application of the driver's foot for braking and is adjusted to a lower amount when the speed of application and/or the acceleration of application is high.

5. Device for actuating a brake system to accomplish a brake assist function, especially for automotive vehicles, wherein a control unit (5) changes a brake force acting in the system depending on an actuating travel sensed by a sensor (2), an actuating speed and/or an acceleration of actuation of a brake pedal (1) when the brake assist function is activated, and the brake force acting in the system corresponds to a ratio between the determined actuating travel and a vehicle deceleration to be effected by the brake system (4).

6. Device as claimed in claim 5,
c h a r a c t e r i z e d in that the brake force acting in the system is augmented with a rising actuating travel, a rising actuating speed and/or a rising acceleration of actuation.

7. Device as claimed in claim 5 or 6,
c h a r a c t e r i z e d in that the brake force acting in the system is reduced continuously to a normal brake force when the actuating travel decreases.

8. Device for actuating a brake system (4) to accomplish a brake assist function, especially for automotive vehicles, wherein a control unit (5) reduces a damping effect and/or a counterforce of a brake pedal (1) when the brake assist function is activated, and the resulting actuating travel of the brake pedal (1) which is determined by way of a sensor (2) of the brake pedal (1) is taken into consideration for determining the vehicle deceleration to be effected by the brake system (4), and wherein the control unit (5) changes a brake force acting in the system depending on the sensed actuating travel, an actuating speed and/or an acceleration of actuation of the brake pedal (1) when the brake assist function is

activated, the said brake force acting in the system corresponding to a ratio between the sensed actuating travel and the deceleration to be effected by the brake system (4).

9. Method for actuating a brake system (4) to accomplish a brake assist function, especially for automotive vehicles, wherein a control unit (5) executes the following steps:

   - reducing a damping effect and/or a counterforce of a brake pedal (1) when the brake assist function is activated, and
   - taking into acccount the resulting actuating travel of the brake pedal (1) which is sensed by way of a sensor (2) of the brake pedal (1) for determining the vehicle deceleration which is to be effected by the brake system.

10. Method for actuating a brake system (4) to accomplish a brake assist function, especially for automotive vehicles, wherein a control unit (5) changes a brake force acting in the system depending on an actuating travel sensed by a sensor (2), an actuating speed and/or an acceleration of actuation of a brake pedal (1) when the brake assist function is activated, and the brake force acting in the system corresponds to a ratio between the determined actuating travel and a vehicle deceleration to be effected by the brake system (4).

11. Method for actuating a brake system (4) to accomplish a brake assist function, especially for automotive vehicles, wherein a control unit (5) executes the following steps:

   - reducing a damping effect and/or a counterforce of a brake pedal (1) when the brake assist function is activated, and

- taking into acccount the resulting actuating travel of the brake pedal (1) which is sensed by way of a sensor (2) of the brake pedal (1) for determining the vehicle deceleration which is to be effected by the brake system, and
- changing a brake force acting in the system depending on the actuating travel, the actuating speed and/or the acceleration of actuation of a brake pedal (1) when the brake assist function is activated, and the brake force acting in the system corresponds to a ratio between the determined actuating travel and a vehicle deceleration to be effected by the brake system (4).

Abstract:

Device and Method for Actuating a Brake System for Automotive Vehicles

The present invention relates to a device for actuating a brake system (4) to accomplish a brake assist function, especially for automotive vehicles. The movement of a brake pedal (1) by the driver can be sensed by way of a travel sensor (2) and supplied to the brake system (4) by way of a signal line (3). Depending on the brake pedal movement determined by the travel sensor (2), a control unit (5) can either change or reduce a damping effect and/or a counterforce of the brake pedal (1) or augment a brake force acting in the system so that the stopping distance of the automotive vehicle is shortened in a safe and comfortable manner. In particular, the driver excercises total control of the braking operation, even when the brake assist function is activated.

(Figure 1)

Fig. 1

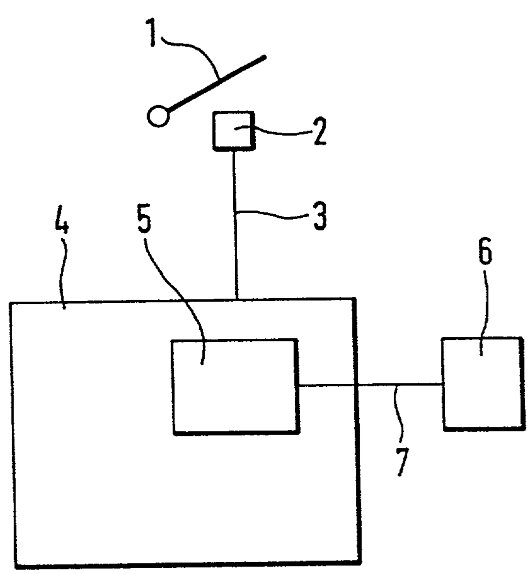
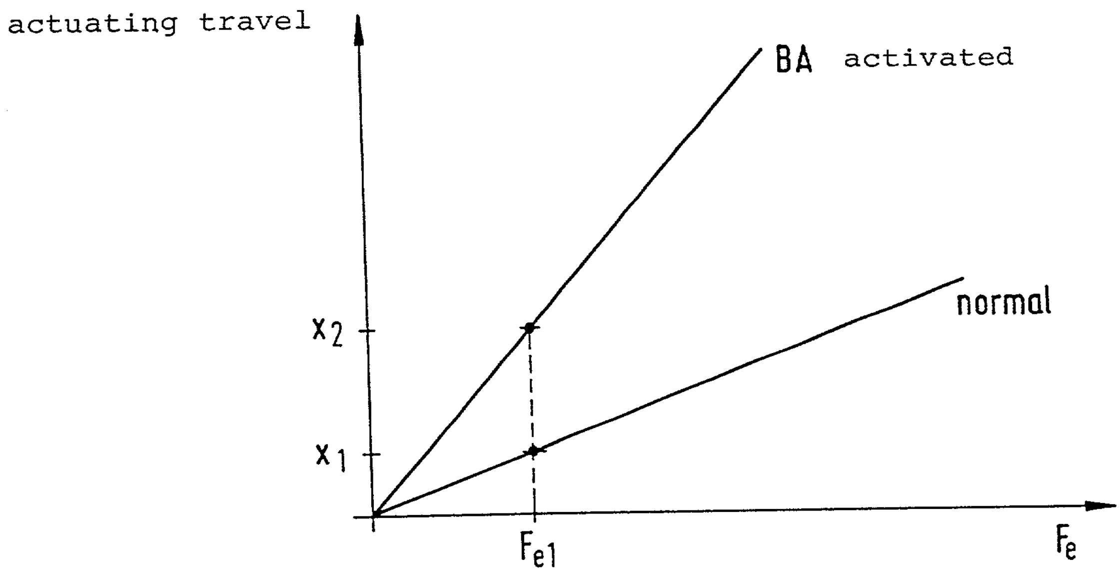


Fig. 2



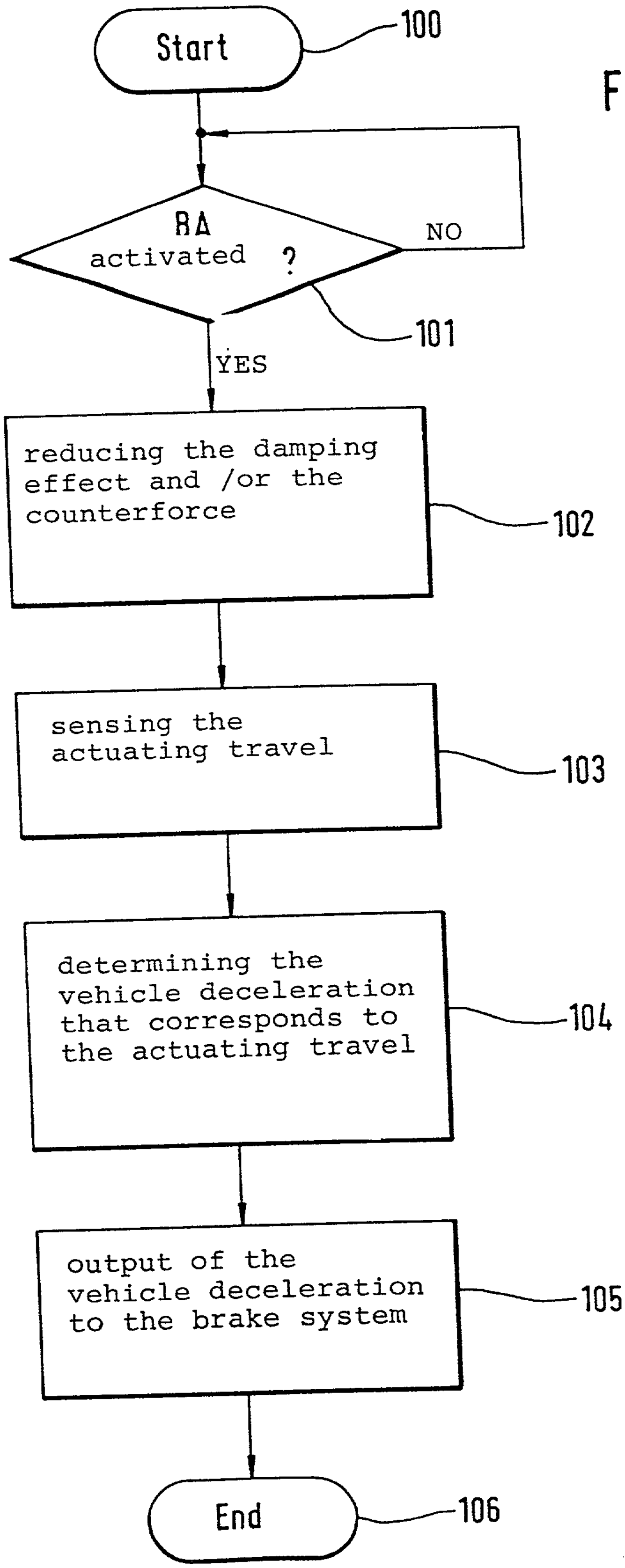
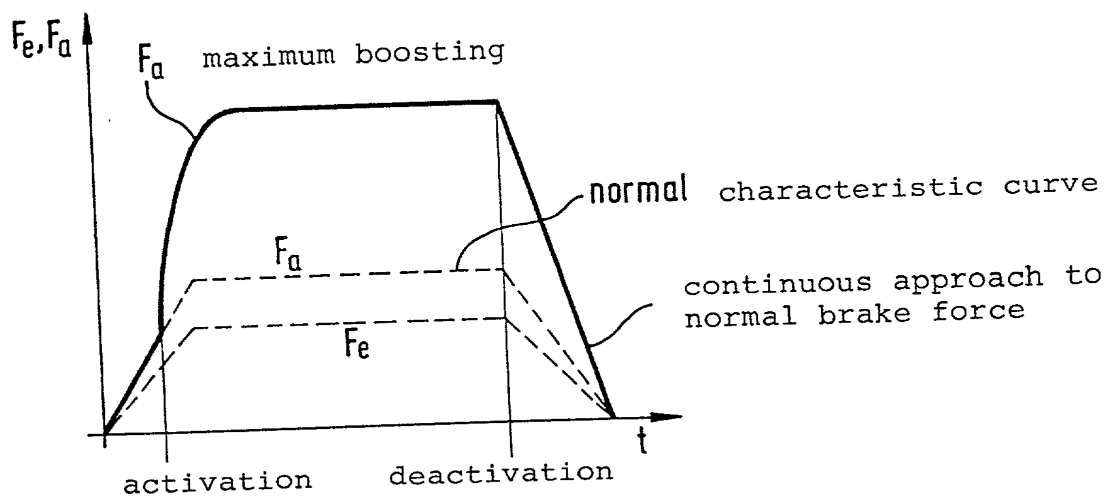

Start
100
RA activated ?
NO
101
YES
reducing the damping effect and /or the counterforce
102
sensing the actuating travel
103
determining the vehicle deceleration that corresponds to the actuating travel
104
output of the vehicle deceleration to the brake system
105
End
106

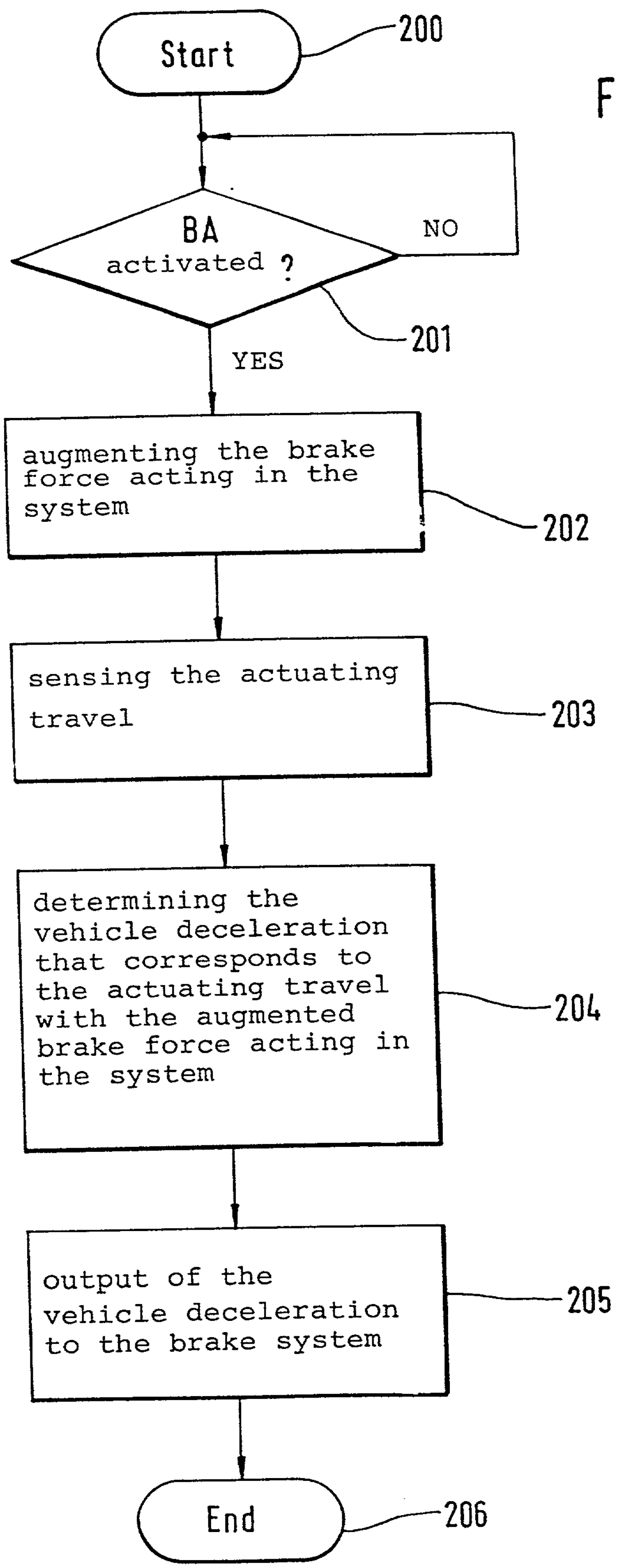
Fig. 3

Fig. 4



Fe,Fa
Fa
maximum boosting
normal
characteristic curve
Fa
continuous approach to
normal brake force
Fe
t
activation
deactivation

Fig. 5


Start
200
BA activated ?
NO
201
YES
augmenting the brake force acting in the system
202
sensing the actuating travel
203
determining the vehicle deceleration that corresponds to the actuating travel with the augmented brake force acting in the system
204
output of the vehicle deceleration to the brake system
205
End
206

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AP9265

Device and Method for Actuating a Brake System for Automotive Vehicles

Technical Field

The present invention generally relates to vehicle brakes, and more particularly relates to a device and a method for actuating a brake system to accomplish a brake assist function, especially for automotive vehicles.

Background of The Invention

Active brake force boosters are known in the art which are used to shorten the stopping distance. The brake force booster referred to is actuated independently by a so-called brake assist system. The mode of operation of the brake assist system which improves the braking power of a vehicle when driven by a less experienced driver and, thus, shortens the stopping distance is e.g. as follows. A travel sensor measures the speed of depression of a brake pedal. When the driver hesitates after the spontaneous application of the brake pedal and does not dare to fully depress the pedal until response of the control of an anti-lock system (ABS), the brake assist system will intervene. An electronic control device calculates from the speed by which the braking operation was initiated by the driver whether emergency braking prevails and sends, by way of a magnetic valve, a command to the booster operating in the ON/OFF mode to deliver the full boosting force. The result is that the vehicle is braked in a boosted manner. To prevent the triggered brake assist system from inadvertently decelerating the vehicle until standstill, a release switch is integrated into the booster. The switch will switch off the brake assist system as soon as the driver releases the brake pedal again. The above principle is e.g. described in German patent DE 42 08 496 C1.

However, the above solution suffers from the disadvantage that an inadvertent quick application of the brake pedal may also trigger independent activation of the brake system. Further, it may occur in an unfavorable case that the system is retained in the independently actuated and activated condition when the driver applies a relatively small amount of force to

the brake pedal (after the activation by e.g. a quick depression of the brake pedal). This may also lead to an undesirable braking operation. When the brake assist system senses that release of the active booster is desired by the driver, further, a jerk may occur because the brake pressure is reduced suddenly.

An object of the present invention is to provide a device and a method for actuating a brake system to perform a brake assist function, especially for automotive vehicles, which achieve safe and comfortable shortening of the stopping distance and avoid unintentional activations.

According to the present invention, a brake pedal can be used which is uncoupled from the brake system inasfar as the quantities, such as the actuating travel of the brake pedal, which are input by the driver into the system and are variable and depend on further inputs, such as the speed of pedal depression, may be converted by a control unit into the vehicle deceleration to be effected by the brake system.

It should be noted in this respect that it is of course possible to use other input variables for converting the driver's input by way of the brake pedal into the desired deceleration. For example, these variables could be the vehicle speed, vehicle load, a measured yaw torque, the current steering angle, etc.

According to the present invention, for example, damping and/or a counterforce of the brake pedal can be adjusted accordingly by way of a control unit, and the control unit can reduce the damping effect and/or the counterforce of the brake pedal accordingly when the brake assist function is activated, and the resulting actuating travel of the brake pedal which is determined by way of a travel sensor of the brake pedal may then be taken into account for determining the deceleration that is to be effected by the brake system.

According to the present invention, it may thus be ensured in a favorable manner that total control of the brake system by the driver is effected when the brake assist function is activated. This is in contrast to the state of the art described hereinabove because the brake

assist system in this prior art actuates the brake system by a corresponding control logic partly independently of the actual position of the brake pedal. This is prevented in the present invention because the deceleration of the brake system is adjusted in dependence on the determined actuating travel (actual position) of the brake pedal. Because the damping effect and/or the counterforce of the brake pedal is reduced, it has to be expected that the driver depresses the brake pedal to a greater extent than in the event when the brake assist function is not activated so that the deceleration effected by the brake system is augmented. The result is a reduced stopping distance.

According to another embodiment, a control unit can change a brake force acting in the system, when the brake assist function is activated, in dependence on an actuating travel determined by the travel sensor, an actuating speed and/or an acceleration of actuation of the brake pedal. The brake force acting in the system can correspond to a ratio of the determined actuating travel to a deceleration to be effected by the brake system. According to this embodiment, the counterforce and/or damping effect of the brake pedal will not change, instead, the driver's input by way of the brake pedal is boosted to a greater extent so that a shortened stopping distance can also be achieved when the brake assist function is activated.

The above embodiments may of course also be implemented in a combined fashion.

Brief Description of The Drawings

Figure 1 is a schematic block diagram of the present invention.

Figure 2 is a graph showing the actuating travel of the brake pedal plotted against the actuating force.

Figure 3 is a flow chart for changing the damping effect and/or the counterforce of the brake pedal.

Figure 4 is a graph showing the counterforce (input force) of the brake pedal or the output force of the brake system which is proportional to the deceleration, plotted against time.

Figure 5 is a flow chart relating to an increase of the brake force acting in the system.

Detailed Description of The Preferred Embodiments

A brake pedal 1 with a travel sensor 2 is shown in Figure 1. The travel sensor 2 can sense the actuating angle of the brake pedal 1 or the actuating travel of the brake pedal 1. The travel sensor 2 is connected to a brake system 4 and, especially, to a control unit 5 by way of a corresponding signal line 3.

In response to the signals of the travel sensor 2 (or the angular sensor), the control unit 5 initially determines whether a brake assist function is required. If this is the case, the control unit 5 will determine, for example, a correspondingly reduced counterforce of the non-illustrated pedal components of the brake pedal 1. These pedal components may include a static portion (spring) and a speed-responsive portion (damping effect). The reduction of the counterforce may be achieved by minimizing damping effect, for example. This may be performed by varying the hydraulic effective cross-section.

The control unit 5 may also leave the damping effect and/or the counterforce of the brake pedal 1 unchanged and increase the brake force acting in the system accordingly when the brake assist function was activated. Of course, influencing the counterforce and/or the damping effect of the brake pedal 1 and of the brake force acting in the system may also be combined.

Depending on the signals sensed by the travel sensor 2 (or angular sensor), a deceleration to be effected by the brake system 4 is now determined by the control unit 5 of the brake system 4. This is done, for example, with the assistance of the determined actuating travel, the

determined actuating speed, and/or the determined acceleration of actuation. Of course, other factors may also be taken into account (for example, the vehicle speed, a yaw velocity, a steering angle, etc.).

Depending on the determined deceleration or the determined braking pressure, wheel brakes 6 are now actuated by way of corresponding control lines 7 in order to bring about the desired deceleration (only one wheel brake 6 is shown for the sake of clarity). The control lines 7 may be electric and/or hydraulic control lines to actuate the wheel brakes 6.

The embodiment of Figure 2 shows a graph of the actuating travel plotted against the actuating force (or the input force F_e) of the brake pedal 2. When the brake assist system is not actuated, an actuating travel of the brake pedal 1 of x1 is produced with an actuating force F_{e1}. When the brake assist system is activated, an actuating travel x2 is produced with the same actuating force F_{e1} of the brake pedal 1. By reducing the damping effect and/or the counterforce of the brake pedal, a stronger or deeper depression of the brake pedal 1 by the driver will be achieved, so that the braking distance can be reduced effectively without impairing the entire control of the braking action or braking operation by the driver. The same applies also to the embodiment according to Figures 4 and 5 (as will be explained in the following).

The purpose of the flow chart according to Figure 3 is to represent a possible operating sequence which is executed, for example, by the control unit 5. This sequence is started in step 100, and a poll is made in step 101 whether the brake assist system or the brake assist function is activated. If this is not the case, a line branching back in between steps 100 and 101 is made.

As has already been explained hereinabove, activation of the brake assist function may be induced, for example, by the control unit 5 when the speed of depression of the brake pedal 1 is higher than a threshold value (this is, however, meant only as an example for a possible activation input of the brake assist function).

Subsequently, a branch to step 102 is made in which the damping effect and/or the counterforce of the brake pedal 1 is reduced. This may be effected in that hydraulic effective cross-sections of the brake pedal 1 are varied accordingly. Subsequently, the actuating travel x of the brake pedal 1 is sensed in step 103, and deceleration that corresponds to the actuating travel is determined in step 104. Then, the determined deceleration is output to the brake system in step 105, and the wheel brakes 6 are subsequently actuated so that this deceleration is reached. The above-mentioned operating sequence terminates in step 106.

The static counterforce of the brake pedal 1 (spring and/or damping effect) may thus be limited to a value which corresponds to a thirty percent braking, for example, because the normal range of action of the driver comprises 0 to 30 % deceleration, that means, the driver knows this range of deceleration or the range of the pedal counterforce. This effects an accelerating force surplus of the pedal force on the brake pedal 1, whereby a quicker foot movement and a stronger or deeper depression of the brake pedal 1 takes place. Thus, the pedal travel that results is an indicator of the deceleration to be achieved. The value for the counterforce to be adjusted may e.g. depend on the speed of application of the foot (sensed by the speed of application of the brake pedal 1). Further, a static counterforce (spring effect) which is responsive to the pedal travel can be reduced to a value which e.g. corresponds to a thirty percent braking (lower force-travel characteristic curve). This also effects an accelerating force surplus of the pedal force on the brake pedal 1 and, thus, a quicker foot movement. Still further, the dynamic counterforce (damping effect) can be reduced to a value of the application speed which is possibly responsive to speed, and it should be taken into consideration in the reduction of damping that the tendency of the brake pedal to vibrations (inherent movement of the brake pedal 1) is reliably prevented. In this arrangement, the static pedal characteristic curve would be maintained, and only the motion-hindering damping force would be reduced.

The pedal travel that results is an indicator of the deceleration to be achieved in all solutions mentioned hereinabove. Of course, all above possibilities can also be combined in any fashion desired.

It should be noted in this respect that the effect of a conventional driver actuation switch can be described by sensing the pedal movement because the pedal is not moved actively.

Figure 4 shows an increase of the brake force acting in the system. The dotted lines show the input force F_e (corresponds to the counterforce) and the output force F_a. The output force F_a is a value which corresponds to the vehicle deceleration. When the brake assist system or the brake assist function is switched on, the brake force acting in the system will be augmented. The uninterrupted solid line shows maximum boosting. After the brake assist system is switched off, the brake force acting in the system will re-approach the normal brake force so that normal brake force will prevail again in the next actuation of the brake system. The approach to the normal brake force takes place continuously or gradually so that the brake force acting in the system is reduced as comfortably as possible.

Of course, any steps desired between the dotted line of F_a and the uninterrupted solid line of F_a are possible. Intermediate values for the brake force acting in the system may be chosen, for example, in dependence on the actuating travel, the actuating speed, and/or the acceleration of actuation of the brake pedal 1 so that the boosted course of the output force F_a is between the solid uninterrupted line and the dotted line. Naturally, the determination of the brake force acting in the system and, thus, also the line representing said may also depend on other factors (for example, the vehicle speed, the vehicle weight, etc.) at a defined time during the activation of the brake assist function and after the activation of the brake assist function (in the phase of the continuous approach to the normal brake force).

A possibility of an operating sequence which can e.g. be executed in the control unit 5 is shown as an example in Figure 5. After start in step 200 there is a branch to step 201 by polling whether the brake assist function is activated or not. If this is not the case, a branching

back in between steps 200 and 201 is made. When the brake assist function is activated, the brake force acting in the system is augmented in step 202. Subsequently, the actuating travel of the brake pedal 1 is sensed in step 203. Then a deceleration which corresponds to the sensed actuating travel is determined in step 204, and the brake force acting in the system that is augmented in step 202 is taken into consideration. The deceleration is then output to the brake system 4 in step 205, and the operating sequence terminates in step 206.

When the brake assist function is activated, the mathematical brake force acting in the system (actuating travel or pedal travel in relation to deceleration) is greatly augmented, and the counterforce of the brake pedal 1 is uninfluenced. The resulting brake force acting in the system may depend on the pedal movement (actuating travel, actuating speed and/or acceleration of actuation) and is fixed during the application of the brake (positive pedal speed). During release of the brake, the brake force acting in the system is reduced continuously again until the normal brake force is reached.

The embodiments according to Figures 2 and 3 as well as 4 and 5 may also be combined, of course.

Further, it should be noted that the modules and functions described in the present invention may be realized alone and/or in any combination desired.

AP9265

Device and Method for Actuating a Brake System for Automotive Vehicles

Abstract of The Invention

The present invention relates to a device for actuating a brake system to accomplish a brake assist function, especially for automotive vehicles. The movement of a brake pedal by the driver can be sensed by way of a travel sensor and supplied to the brake system by way of a signal line. Depending on the brake pedal movement determined by the travel sensor, a control unit can either change or reduce a damping effect and/or a counterforce of the brake pedal or augment a brake force acting in the system so that the stopping distance of the automotive vehicle is shortened in a safe and comfortable manner. In particular, the driver exercises total control of the braking operation, even when the brake assist function is activated.

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AP9265

[PC 9265]

Device and Method for Actuating a Brake System for Automotive Vehicles

Technical Field

The present invention generally relates to vehicle brakes, and more particularly relates to a device and a method for actuating a brake system to accomplish a brake assist function, especially for automotive vehicles.

Background of The Invention

Active brake force boosters are known in the art which are used to shorten the stopping distance. The brake force booster referred to is actuated independently by a so-called brake assist system. The mode of operation of the brake assist system which improves the braking power of a vehicle when driven by a less experienced driver and, thus, shortens the stopping distance is e.g. as follows. A travel sensor measures the speed of depression of a brake pedal. When the driver hesitates after the spontaneous application of the brake pedal and does not dare to fully depress the pedal until response of the control of an anti-lock system (ABS), the brake assist system will intervene. An electronic control device calculates from the speed by which the braking operation was initiated by the driver whether emergency braking prevails and sends, by way of a magnetic valve, a command to the booster operating in the ON/OFF mode to deliver the full boosting force. The result is that the vehicle is braked in a boosted manner. To prevent the triggered brake assist system from inadvertently decelerating the vehicle until standstill, a release switch is integrated into the booster. The switch will switch off the brake assist system as soon as the driver releases the brake pedal again. The above principle is e.g. described in German patent DE 42 08 496 C1.

However, the above solution suffers from the disadvantage that an inadvertent quick application of the brake pedal may also trigger independent activation of the brake system.

Further, it may occur in an unfavorable case that the system is retained in the independently actuated and activated condition when the driver applies a relatively small amount of force to the brake pedal (after the activation by e.g. a quick depression of the brake pedal). This may also lead to an undesirable braking operation. When the brake assist system senses that release of the active booster is desired by the driver, further, a jerk may occur because the brake pressure is reduced suddenly.

An object of the present invention is to provide a device and a method for actuating a brake system to perform a brake assist function, especially for automotive vehicles, which achieve safe and comfortable shortening of the stopping distance and avoid unintentional activations.

[This object is achieved according to the features of the independent patent claims. The dependent patent claims show favorable improvements and embodiments of the present invention.]

According to the present invention, a brake pedal can be used which is uncoupled from the brake system inasfar as the quantities, such as the actuating travel of the brake pedal, which are input by the driver into the system and are variable and depend on further inputs, such as the speed of pedal depression, may be converted by a control unit into the vehicle deceleration to be effected by the brake system.

It should be noted in this respect that it is of course possible to use other input variables for converting the driver's input by way of the brake pedal into the desired deceleration. For example, these variables could be the vehicle speed, vehicle load, a measured yaw torque, the current steering angle, etc.

According to the present invention, for example, damping and/or a counterforce of the brake pedal can be adjusted accordingly by way of a control unit, and the control unit can reduce the damping effect and/or the counterforce of the brake pedal accordingly when the brake assist function is activated, and the resulting actuating travel of the brake pedal which is determined

by way of a travel sensor of the brake pedal may then be taken into account for determining the deceleration that is to be effected by the brake system.

According to the present invention, it may thus be ensured in a favorable manner that total control of the brake system by the driver is effected when the brake assist function is activated. This is in contrast to the state of the art described hereinabove because the brake assist system in this prior art actuates the brake system by a corresponding control logic partly independently of the actual position of the brake pedal. This is prevented in the present invention because the deceleration of the brake system is adjusted in dependence on the determined actuating travel (actual position) of the brake pedal. Because the damping effect and/or the counterforce of the brake pedal is reduced, it has to be expected that the driver depresses the brake pedal to a greater extent than in the event when the brake assist function is not activated so that the deceleration effected by the brake system is augmented. The result is a reduced stopping distance.

According to another embodiment, a control unit can change a brake force acting in the system, when the brake assist function is activated, in dependence on an actuating travel determined by the travel sensor, an actuating speed and/or an acceleration of actuation of the brake pedal. The brake force acting in the system can correspond to a ratio of the determined actuating travel to a deceleration to be effected by the brake system. According to this embodiment, the counterforce and/or damping effect of the brake pedal will not change, instead, the driver's input by way of the brake pedal is boosted to a greater extent so that a shortened stopping distance can also be achieved when the brake assist function is activated.

The above embodiments may of course also be implemented in a combined fashion.

[Embodiments of the present invention will be explained in detail in the following by way of schematic drawings. In the drawings,]

Brief Description of The Drawings

Figure 1 is a schematic block diagram of the present invention.

Figure 2 is a graph showing the actuating travel of the brake pedal plotted against the actuating force.

Figure 3 is a flow chart for changing the damping effect and/or the counterforce of the brake pedal.

Figure 4 is a graph showing the counterforce (input force) of the brake pedal or the output force of the brake system which is proportional to the deceleration, plotted against time.

Figure 5 is a flow chart relating to an increase of the brake force acting in the system.

Detailed Description of The Preferred Embodiments

A brake pedal 1 with a travel sensor 2 is shown in Figure 1. The travel sensor 2 can sense the actuating angle of the brake pedal 1 or the actuating travel of the brake pedal 1. The travel sensor 2 is connected to a brake system 4 and, especially, to a control unit 5 by way of a corresponding signal line 3.

In response to the signals of the travel sensor 2 (or the angular sensor), the control unit 5 initially determines whether a brake assist function is required. If this is the case, the control unit 5 will determine, for example, a correspondingly reduced counterforce of the non-illustrated pedal components of the brake pedal 1. These pedal components may include a static portion (spring) and a speed-responsive portion (damping effect). The reduction of the counterforce may be achieved by minimizing damping effect, for example. This may be performed by varying the hydraulic effective cross-section.

The control unit 5 may also leave the damping effect and/or the counterforce of the brake pedal 1 unchanged and increase the brake force acting in the system accordingly when the brake assist function was activated. Of course, influencing the counterforce and/or the damping effect of the brake pedal 1 and of the brake force acting in the system may also be combined.

Depending on the signals sensed by the travel sensor 2 (or angular sensor), a deceleration to be effected by the brake system 4 is now determined by the control unit 5 of the brake system 4. This is done, for example, with the assistance of the determined actuating travel, the determined actuating speed, and/or the determined acceleration of actuation. Of course, other factors may also be taken into account (for example, the vehicle speed, a yaw velocity, a steering angle, etc.).

Depending on the determined deceleration or the determined braking pressure, wheel brakes 6 are now actuated by way of corresponding control lines 7 in order to bring about the desired deceleration (only one wheel brake 6 is shown for the sake of clarity). The control lines 7 may be electric and/or hydraulic control lines to actuate the wheel brakes 6.

The embodiment of Figure 2 shows a graph of the actuating travel plotted against the actuating force (or the input force F_e) of the brake pedal 2. When the brake assist system is not actuated, an actuating travel of the brake pedal 1 of x1 is produced with an actuating force F_{e1}. When the brake assist system is activated, an actuating travel x2 is produced with the same actuating force F_{e1} of the brake pedal 1. By reducing the damping effect and/or the counterforce of the brake pedal, a stronger or deeper depression of the brake pedal 1 by the driver will be achieved, so that the braking distance can be reduced effectively without impairing the entire control of the braking action or braking operation by the driver. The same applies also to the embodiment according to Figures 4 and 5 (as will be explained in the following).

The purpose of the flow chart according to Figure 3 is to represent a possible operating sequence which is executed, for example, by the control unit 5. This sequence is started in step 100, and a poll is made in step 101 whether the brake assist system or the brake assist function is activated. If this is not the case, a line branching back in between steps 100 and 101 is made.

As has already been explained hereinabove, activation of the brake assist function may be induced, for example, by the control unit 5 when the speed of depression of the brake pedal 1 is higher than a threshold value (this is, however, meant only as an example for a possible activation input of the brake assist function).

Subsequently, a branch to step 102 is made in which the damping effect and/or the counterforce of the brake pedal 1 is reduced. This may be effected in that hydraulic effective cross-sections of the brake pedal 1 are varied accordingly. Subsequently, the actuating travel x of the brake pedal 1 is sensed in step 103, and deceleration that corresponds to the actuating travel is determined in step 104. Then, the determined deceleration is output to the brake system in step 105, and the wheel brakes 6 are subsequently actuated so that this deceleration is reached. The above-mentioned operating sequence terminates in step 106.

The static counterforce of the brake pedal 1 (spring and/or damping effect) may thus be limited to a value which corresponds to a thirty percent braking, for example, because the normal range of action of the driver comprises 0 to 30 % deceleration, that means, the driver knows this range of deceleration or the range of the pedal counterforce. This effects an accelerating force surplus of the pedal force on the brake pedal 1, whereby a quicker foot movement and a stronger or deeper depression of the brake pedal 1 takes place. Thus, the pedal travel that results is an indicator of the deceleration to be achieved. The value for the counterforce to be adjusted may e.g. depend on the speed of application of the foot (sensed by the speed of application of the brake pedal 1). Further, a static counterforce (spring effect) which is responsive to the pedal travel can be reduced to a value which e.g. corresponds to a thirty percent braking (lower force-travel characteristic curve). This also effects an

accelerating force surplus of the pedal force on the brake pedal 1 and, thus, a quicker foot movement. Still further, the dynamic counterforce (damping effect) can be reduced to a value of the application speed which is possibly responsive to speed, and it should be taken into consideration in the reduction of damping that the tendency of the brake pedal to vibrations (inherent movement of the brake pedal 1) is reliably prevented. In this arrangement, the static pedal characteristic curve would be maintained, and only the motion-hindering damping force would be reduced.

The pedal travel that results is an indicator of the deceleration to be achieved in all solutions mentioned hereinabove. Of course, all above possibilities can also be combined in any fashion desired.

It should be noted in this respect that the effect of a conventional driver actuation switch can be described by sensing the pedal movement because the pedal is not moved actively.

Figure 4 shows an increase of the brake force acting in the system. The dotted lines show the input force F_e (corresponds to the counterforce) and the output force F_a. The output force F_a is a value which corresponds to the vehicle deceleration. When the brake assist system or the brake assist function is switched on, the brake force acting in the system will be augmented. The uninterrupted solid line shows maximum boosting. After the brake assist system is switched off, the brake force acting in the system will re-approach the normal brake force so that normal brake force will prevail again in the next actuation of the brake system. The approach to the normal brake force takes place continuously or gradually so that the brake force acting in the system is reduced as comfortably as possible.

Of course, any steps desired between the dotted line of F_a and the uninterrupted solid line of F_a are possible. Intermediate values for the brake force acting in the system may be chosen, for example, in dependence on the actuating travel, the actuating speed, and/or the acceleration of actuation of the brake pedal 1 so that the boosted course of the output force F_a is between the solid uninterrupted line and the dotted line. Naturally, the determination of the

brake force acting in the system and, thus, also the line representing said may also depend on other factors (for example, the vehicle speed, the vehicle weight, etc.) at a defined time during the activation of the brake assist function and after the activation of the brake assist function (in the phase of the continuous approach to the normal brake force).

A possibility of an operating sequence which can e.g. be executed in the control unit 5 is shown as an example in Figure 5. After start in step 200 there is a branch to step 201 by polling whether the brake assist function is activated or not. If this is not the case, a branching back in between steps 200 and 201 is made. When the brake assist function is activated, the brake force acting in the system is augmented in step 202. Subsequently, the actuating travel of the brake pedal 1 is sensed in step 203. Then a deceleration which corresponds to the sensed actuating travel is determined in step 204, and the brake force acting in the system that is augmented in step 202 is taken into consideration. The deceleration is then output to the brake system 4 in step 205, and the operating sequence terminates in step 206.

When the brake assist function is activated, the mathematical brake force acting in the system (actuating travel or pedal travel in relation to deceleration) is greatly augmented, and the counterforce of the brake pedal 1 is uninfluenced. The resulting brake force acting in the system may depend on the pedal movement (actuating travel, actuating speed and/or acceleration of actuation) and is fixed during the application of the brake (positive pedal speed). During release of the brake, the brake force acting in the system is reduced continuously again until the normal brake force is reached.

The embodiments according to Figures 2 and 3 as well as 4 and 5 may also be combined, of course.

Further, it should be noted that the modules and functions described in the present invention may be realized alone and/or in any combination desired.

AP9265

[Abstract:]

Device and Method for Actuating a Brake System for Automotive Vehicles

Abstract of The Invention

The present invention relates to a device for actuating a brake system [(4)] to accomplish a brake assist function, especially for automotive vehicles. The movement of a brake pedal [(1)] by the driver can be sensed by way of a travel sensor [(2)] and supplied to the brake system [(4)] by way of a signal line [(3)]. Depending on the brake pedal movement determined by the travel sensor [(2)], a control unit [(5)] can either change or reduce a damping effect and/or a counterforce of the brake pedal [(1)] or augment a brake force acting in the system so that the stopping distance of the automotive vehicle is shortened in a safe and comfortable manner. In particular, the driver [excercises]<u>exercises</u> total control of the braking operation, even when the brake assist function is activated.

[(Figure 1)]

AP9265

Declaration and Power of Attorney for Patent Application
Erklärung für Patentanmeldungen mit Vollmacht

German Language Declaration

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Device and Method for Actuating a Brake System for Automotive Vehicles

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Prior Foreign Applications
(Frühere ausländische Anmeldungen)

			Priority Not Claimed Priorität nicht beansprucht
198 25 231.5	**Germany**	**5/June/1998**	☐
Number	Country	Day/Month/Year Filed	☐

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